THE MODEL ENGINEER

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Smoke Rings

Models Three Thousand Years Hence

THOSE of my readers who listen in to the radio discussions of the "Brains Trust" will no doubt remember that, at a recent session, this learned body was asked what articles in current use they would suggest as appropriate for burial, or preservation in some suitable place, so that, when disclosed in three thousand years time, the then inhabitants of the world might be able to obtain some authentic information as to the manners and customs of the present century. I am afraid the replies forthcoming from the Trust on this occasion did not show much imagination. Beyond suggesting suits of male and female clothing, a copy of a daily newspaper, and some photographs, the brains of the Trust failed to operate. It is true that one member suggested the inclusion of an aeroplane, but it was considered that the difficulty of burying an aeroplane ruled this out. No one thought of the ideal plan of preserving models. The ancient Egyptians realised the informative value of representative models, and excavations in the tombs of Egyptian kings have brought to light a number of miniature replicas of articles of craftsmanship and utility which did service in ancient days. Imagine the instructive nature of actual models of ships, aeroplanes, locomotives, motor vehicles, engines, boilers, machine tools, and even notable examples of public and private buildings. If carefully interned in air-tight cases records of this kind would probably survive a very prolonged period of burial, and would be of enormous interest to the future inhabitants of this world. What they will think of our present-day methods of transport and power generation and distribution I do not know, and it would require a prophet of exceptional ability to forecast the changes which the years will bring about. So long as transport remained on the solid earth and the seven seas, changes in vehicles and in water-borne craft moved slowly, and were only speeded up when power began to replace horses or sails. Now that the conquest of the air has been effected, transport in the future holds boundless possibilities, and with the astonishing developments of radio transmission which undoubtedly lie ahead, world communication and vision will become a commonplace achievement to everybody, as also will the wireless distribution of light and power. Three thousand years hence the *Queen Mary* liner, the "Royal Scot" locomotive, and the Rolls Royce car will be quaint and perhaps amusing curiosities of a past civilisation, but their memories may at least be preserved in the form of representative models. The inclusion in the collection of models of tanks and guns and other weapons of war would be an effective reminder of the madness of this age when so much ability and ingenuity is devoted by human beings to their mutual destruction. A counter influence would be provided by the preservation of a volume of THE MODEL ENGINEER, which would reveal to posterity that in the twentieth century there lived at least some sane and sober-minded people who loved good craftsmanship and who appreciated the value of an instructive and worth-while hobby.

. . . —

The Silent Ones

IN the course of a long letter recounting the adventures of a varied and successful engineering career, Mr. W. F. Anderson recently wrote :—"I have had innumerable pleasures from THE MODEL ENGINEER, and whilst my first joy was with the first issue brought home by my brother—what a thrill! —yet I have never given you a word of appreciation, but we silent ones do value it. So if you don't hear from us, perhaps it is because we are a bit shy, but we do appreciate it, even at 62 years." I hope Mr. Anderson's lead will induce a few more "silent ones" to come forward. Their letters are always a source of pleasure and encouragement, both to me and to my staff.

Percival Marshall

*Small Capstan Lathe Tools

Notes on "tooling up" for repetition work, with special application to the small capstan attachment recently described in the "M.E."

By "NED"

ALTHOUGH the vee and roller steady toolholders, described in the preceding instalments of these notes, may be regarded as the most efficient means of running down solid stock for such purposes as making screws, bolts, rivets, etc., and are applicable without difficulty in the great majority of cases, there are occasions when their use is either entirely impracticable or inconvenient, and some other method of steadying the work against deflection under the pressure of the cutting tool must be adopted.

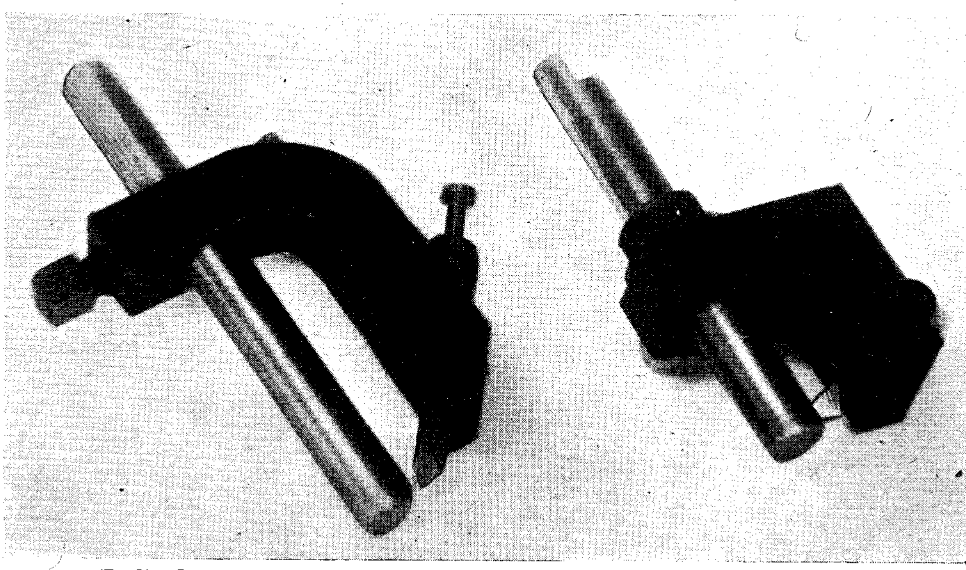
The use of bush steadies, in connection with the simple box toolholder, has already been mentioned (see Fig. 7) ; in this particular case, however, the construction of the toolholder allows of only one position for the steady bush, that is, in advance of the cutting tool. This undoubtedly limits the usefulness of such a toolholder, but it is, of course, possible to modify its design so as to allow of using a steady bush behind the tool point if desired. Either the box form of toolholder, or the open type, such as the simple knee toolholder shown in Fig. 6, may be thus equipped, and in cases where the finished diameter of the work is very small, the shank may be bored out and used as the bush holder. The use of such expedients is comparatively uncommon, but may, in certain circumstances, help to solve many a practical problem.

* *Continued from page 254, "M.E.," March 12, 1942.*

"Plug" or Pilot Steadies

In work which is turned from tube, or has been drilled with a central hole, it is possible to invert the principle of the bush steady by equipping the toolholder with a centre pilot which fits the bore of the hole and supports the work from the inside. This method is very extensively used in the production of light bushes, sleeves, ferrules, and pipe connections ; it is most useful when the bore of the hole is comparatively large and the finished work rather thin in the wall. The hole must, of course, be parallel, and within fairly close limits of diametral accuracy ; for this reason a reamered bore is preferable, but plug steadies are often employed successfully in holes which have just been drilled in one operation.

The normal practice with hollow work, whether produced from solid stock or otherwise, is to drill or bore the inside at an early stage in the operation, before turning the outside, or between roughing and finishing cuts. In such cases, it is very convenient to use a plug steady tool for finishing, and the latter will often be found to give the most



Toolholders with pilot steadies, for operating on centrally drilled work.

satisfactory results in respect of accuracy and finish. The most common form of toolholder for this purpose is an ordinary knee toolholder with the shank extended in front of the yoke to carry (or act as) the pilot.

If it is desired to make the tool adaptable to deal with a range of bore sizes, it would be a sound policy to use a hollow shank, with provision for the insertion of variously sized pilots. This course, however, does not appear to be very commonly adopted in practice, probably, because it is so easy to turn a shank and pilot in one piece to suit the work in hand. The working surface of the pilot should be case-hardened, and in common with other forms of steadies, highly polished. If the pilot is intended to work in a blind hole, it is—in theory at least—necessary to provide a passage for the escape of air or lubricant trapped in the hole. There are many cases where this is neglected, and nothing very terrible seems to happen; but the provision of an oil way, for preference a steep spiral groove, in the surface of the pilot, is always an advantage, whether it is used in blind or open bores.

Fig. 10 shows a simple plug steady toolholder suitable for use on a short running-down cut. The knee is in this case cut from solid mild steel, and is clamped to the shank by means of a single set-screw, being thus capable of endwise adjustment on the shank so that the distance of the end of the pilot in advance of the tool may be varied. It is usual to allow a fair length of the pilot to enter the hole before the tool begins to cut, in order to provide ample bearing surface for steadying; but in many cases, where the depth of the bore is limited, the pilot can only be allowed a small amount of advance.

The tool point is set obliquely in the yoke, so that its cutting edge can be brought at least flush with the front end of the latter. This is a useful provision in cases where it may be necessary to work close up to the chuck jaws, or to a flange on the work; it also improves general accessibility and visibility, besides facilitating the regrinding of the tool point without undue waste of material. The top face of the tool is ground obliquely away in both planes to provide front and side rake, the latter being the more important, as the tool does most of its work on the leading edge.

Note that in order to maintain proper rake and clearance angles, the slot for the cutter must be below the centre line of the yoke, so as to bring the cutting edge exactly on the plane of diametral adjustment. An error which is frequently made by amateur tool-makers (and is not unknown among professionals) is to slot toolholders symmetrically on the centre line, so that the top edge of the tool is well above centre when it is in position. It is true that the rake and clearance angles can be adjusted by grinding to suit this position, but some waste of tool steel is involved by this method, and the angles thus produced are only correct for one diametral setting.

Similar tools to that shown in Fig. 9 have been used by the writer for bevel and short taper forming, or with two tools in tandem,

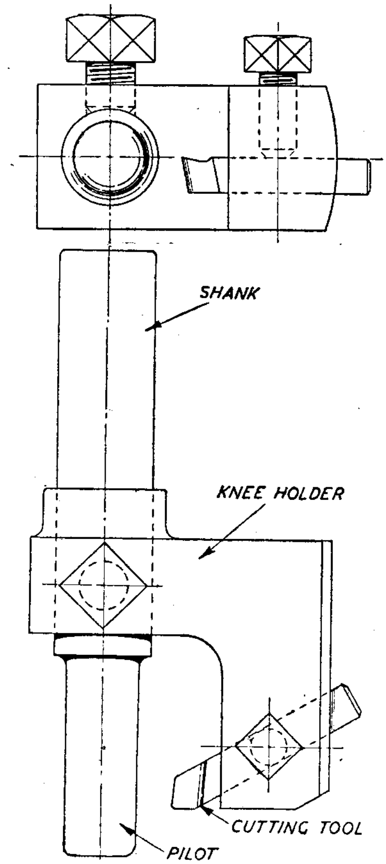


Fig. 10. Knee toolholder with pilot steady for short running-down cuts on hollow work.

for stepping the outside diameter of the work. In one case a cutter similar to that shown was used for running-down, while a second cutter inserted at about 45 deg. in the angle of the yoke, and shaped to a concave radius at the point, was used for producing a rounded corner, accurate to specified radius, on the corner of the work.

The holder shown in Fig. 11 is generally similar to the preceding example, except that it is lighter in construction and intended to deal with a greater length of cut. A refinement in its design, which may be found useful when it is required to produce finished work of accurate dimensions, is the

provision of a feed screw behind the cutter. The clamping of the latter is effected by means of a long set-screw which passes longitudinally through the holder ; this is more complicated than the more usual cross screw, but is a more secure method of ensuring the correct positioning of the tool point, and also leaves the nose of the holder absolutely clear of all obstructions, so that it would be possible to use the tool in a recess or shallow hole of large diameter.

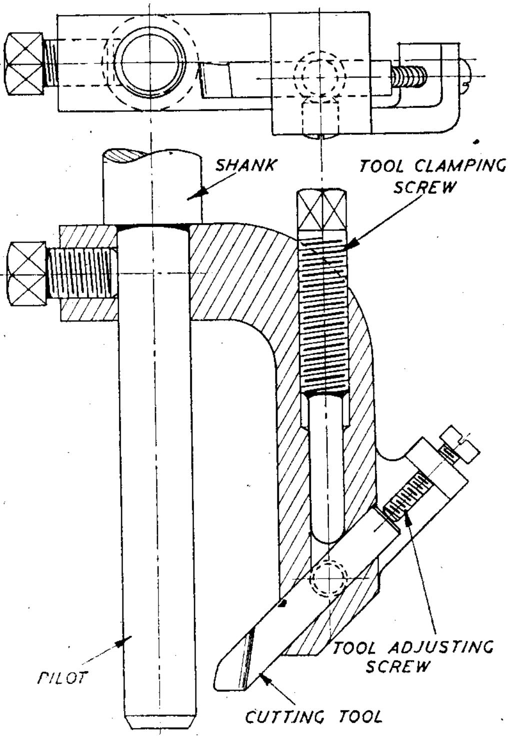


Fig. 11. Another pilot steady toolholder, equipped with screw adjustment to the cutting tool.

In order to form the carrier for the tool-adjusting screw, a bent strip of $\frac{1}{8}$-in. sheet steel is brazed on to the bottom face of the holder leg, which in this case is made from square bar material by hot bending. This strip, incidentally, forms the " floor " of the slot which holds the cutter, so that the operation of forming the slot is facilitated, as it is simply a square groove cut diagonally across the square leg.

If desired, height adjustment of the tool may be provided by sunk set-screws above and below the cutter. These screws have only a light duty to perform, as they do not have to clamp the cutter, thus ordinary slotted grub-screws may be used. In the example illustrated, only one such screw was used, on the underside of the slot, to take up clearance under the cutter.

Other Forms of Steadies

Both bush and pilot steadies are often used in capstan and turret lathe practice, apart from their application in conjunction with running-down toolholders. That is to say, the steady *alone* is carried in the capstan or turret head, and brought up to engage the work, the traversing slide then being locked, and the work operated on by tools carried in the cross slide. Such operations as forming, chasing, or parting-off may be considerably speeded up or facilitated in this way, especially if the work has little inherent rigidity or extends some way from the chuck. In parting-off small parts at high speed, the use of a steady in this way has the additional advantage that it reduces or entirely eliminates the " pip " on the cut end, and also retains the part after separation, so that the operator does not have to search for it among the swarf.

Centres of more or less orthodox type, both male and female, are sometimes used in a somewhat similar manner, to support the overhanging end of work while it is being operated on by cross slide tools. In production practice, both centres and steadies intended for use in this way are often equipped with ball- or roller-bearings to withstand heavy and continuous duty. There is, however, little advantage in thus mounting a bush or plug steady if it is used in a traversing toolholder, as it will slide more freely endwise if prevented from rotating.

Fixed and travelling steadies of the type usually applied to centre lathes are not used a great deal in capstan or turret lathe practice. There are, however, occasions when their use is justified ; for instance, long lengths of work which have to be operated on internally and call for no external machining, may be supported at one end in a collet or jaw chuck, and at the other by the conventional three-point steady, or an improvised bush or pad steady of any kind which can be clamped to the lathe bed.

The use of any kind of steady in lathe work is bound to increase friction to some extent, and therefore to affect the amount of power required to drive the lathe. In most cases the increase is inappreciable, but its possible effect should not be neglected ; neither should it be forgotten that the friction will increase the heat generated in the operation, and for this reason, if no other, a copious supply of lubricant should always be maintained. Ordinary cutting oils and soluble compounds are usually effective in keeping steadies lubricated, but there are cases where the use of a steady will call for applying a coolant of more " body " or lubricating quality than would otherwise be necessary.

(To be continued)

Our Division Plate Competition

By PERCIVAL MARSHALL, C.I.Mech.E.

WHEN Mr. L. R. Fooks kindly offered his prize of £2 2s. for a method of making an accurate 17-hole division plate I do not think he realised the fluttering in model engineering dove-cotes which he would cause. Nor do I think he visualised the congested state of the editorial desk, when the Post Office had delivered the many rolls of drawings and sheets of sketches and manuscripts which have been submitted by the competitors. I am a little doubtful, too, if he realised the heavy tax imposed on the editorial brain in its endeavour to award the prize, without fear or favour, from such a display of patient and ingenious endeavour. However, from the point of view of wide-spread interest, and of practical contribution to workshop knowledge, I think the competition may be regarded as a distinct success.

In all, fifty-nine entries were received, representing many different types of solution. Before attempting to allocate the prize, I classified these according to the methods of division adopted, and found they fell into one or other of the following groups—(1), Indexing by a divided or perforated band wrapped round a faceplate or wooden disc (eleven entries); (2), The use of steel distance rollers or buttons set in a circular groove, or otherwise mounted on the plate to be drilled (twelve entries); (3), The employment of a drilling arm or jig, with either fixed or adjustable centres (fifteen entries); (4) Division by a long radius-rod with a pointer set to register over an extended scale on a large disc or arc of a circle (eleven entries); and (5), A miscellaneous group of entries which only partly solved the problem, or were not sufficiently accurate in the methods employed (ten entries).

No stipulation as to novelty was made, and many competitors described methods which, if not widely known, are at least not new. But even old methods, if adapted to the skill and resources of the average model engineer, have not been ruled out of consideration. Some competitors seemed to think that their task was ended when they had devised means of accurately scribing and centre-popping 17 divisions on the prescribed pitch circle. They gave no thought to the probable wandering of the drill point, and even where guide bushes were used for the drill, possible inaccuracy due to the wear of the bush was sometimes overlooked. Another source of error crept into some of the solutions, where the distance between the first two holes having been arrived at by calculation, this measurement was repeated round the pitch circle by means of a jig. If there is the slightest inaccuracy in the spacing of these first two holes, it produces a cumulative error, plus or minus, as progress round the circle proceeds.

After a prolonged and careful study of all the entries, I have decided to award the prize to Mr. John Latta, of "Haysmuir," 35, Racecourse Road, Ayr. He does not claim originality, but he presents his solution in a clear and thoughtful manner, and has had due consideration for the final accuracy of the job. His method involves a minimum of calculation, and, though it calls for careful and precise workmanship, is not too elaborate for the model engineer to adopt. Several other entries were very ingenious and workmanlike and would, no doubt, give results of a high degree of exactitude, and the final choice was not easy to make. Still other competitors submitted methods perhaps simpler in character, but yielding results, which though sufficiently good for many requirements, were not really accurate from a precision point of view. The visual registration of pointers over a divided scale is a case in point.

It is not possible to award every competitor a prize, but I can at least express my appreciation of the great interest this contest has aroused, and of the care and trouble so many competitors have taken to put their ideas on paper. I hope it has provided them with some pleasant, and perhaps profitable reflection. I know of at least one instance where it has afforded agreeable recreation for the occupant of a sick bed. Another competitor, Mr. H. O. Clark, of Norwich, not only submitted some excellent drawings with his solution, but actually sent a division plate made in accordance with his method. I could not help but admire this additional indication of the thoroughness with which he approaches any model engineering job.

Mr. Latta's solution will be published at an early date, and I shall in addition publish a small selection from the various other types of solution, the senders of which will be remunerated at our normal contribution rates.

Mr. A. OUGHTON

Comments on Gear Cutting —

and offers a few suggestions

I HAVE read with pleasure the stimulating and informative articles and letters on the subject of gear cutting, and first I would refer to Mr. Rodway's letter in the February 12th issue. Appended to the illustration of his tool for making a fly-cutter is some text which says : " Two pins to represent tooth *flanks*." The phrase also appears in Mr. Bradley's reply. He remarks that according to his data the *flank* radius of the tooth should be 0.0937 in.

It would seem to me that these remarks should refer to the *face* radius of the gear tooth. That is, the portion of the tooth above the pitch line—the flank being below pitch line.

With regard to the correct figures, there is no standard, and according to Grant's Odoulograph method the radius of the flank for a 40 D.P. 30 tooth gear is 0.0690 and for the *face* 0.100. This is about equally between the two measurements already given, and would bring the pins in Mr. Rodway's sketch to 0.200 in. diameter.

The fly cutter method of producing small gears is an old and well tried expedient to get the job done despite difficulties. Many thousands of gears have been produced by it.

But when Mr. Bradley remarks " there seems no reason why Mr. Rodway's method should not be applied to multi-tooth cutters," he re-enters a " vicious circle." To do so would involve some form of gearing between the cutter blank and tool post, and in effect comes on to a backing-off device.

Such an appliance is quite possible and has been in use, in fact. But it is expensive and complicated—so much so as to render it hardly worth while for the average model maker, bearing in mind the infrequent use to which he could put it.

There are, however, two alternative ways of making and backing off these cutters open to anyone with a lathe, which I will describe later.

Milling Cutters

First, however, a word about milling cutters in general. Model making lathes and milling attachments being what they are, the operator is at a disadvantage in using standard type milling cutters. The use of widely spaced teeth puts an undue strain on the small lathe and milling attachment, and I would suggest a much larger number of teeth. In fact, I think it would be a definite move forward if model makers themselves, or a firm specially catering for their requirements, were to standardise on a series of milling cutters more suited to the tools available to the model maker. As a start I would suggest a ⅜-in. mandrel, 1⅛ in. diameter, teeth spaced ⅛ in. apart. Such fine teeth do not have to stand the individual jar of more widely spaced teeth. The following tooth " takes up " more quickly, and, the cut being smaller, results in a smoother cut, with less strain on the appliances used.

The Cutter

The first job is to make a fluted end-mill of exactly 0.200 in. diameter. The fluting need only extend about ⅜ in. from the end along the shank, the remaining portion of the shank being reduced in diameter to enable the teeth of the flutes to be readily filed up in the vice. The end teeth will be produced in the same way. Harden and temper and set up in chuck to run true.

The next requirement, if no milling attachment and elevating slide are available, is to make a mandrel to hold the blank in the tool rest. A piece of square stock 5 in. long is required, reduced at one end to ⅜ in. diameter and threaded to take a nut to clamp the blank in place. The top side of the square section adjacent to the threaded portion is provided with a locating pin projecting sufficiently to engage with the teeth of the cutter when clamped in place.

Normally, the front face of the tooth to be cut will be set slightly over the vertical to provide the necessary clearance angle, which is about 7 degrees. The angle will depend on the spacing of the teeth, the idea being to cut the periphery and radius of each tooth in a straight line, so that the face of the following tooth shall project above the finishing line of the tooth being cut, to the extent of the angle indicated. It is therefore necessary to set the stop pin in the correct position to provide this clearance.

With the blank in place on the spindle, pack up the holder in the tool rest, in a similar position to that which an ordinary parting-tool would occupy, so that the point of the tooth to be cut coincides with

the periphery of the end-mill. Feed forward for the length of the tooth, withdraw, and re-set blank for the next tooth. It will be necessary to use the cross slide slightly to obtain a flat on this part of the tooth.

When that operation is completed, repack the holder in tool rest to bring the base line of blank (indicated in Figs. 7, 8 and 9 on page 463 of December 11th issue) to the periphery of the end-mill, and adjust cross slide to make quite certain that the cut to be taken will coincide with the root space measurement of 0.052 in. shown on Fig. 6. After completing the teeth on one side of the blank, take saddle back to clear end-mill, adjust cross slide, and proceed to work on the other side of the blank.

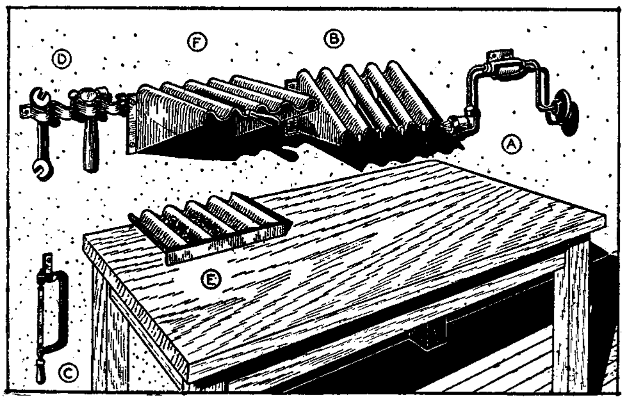
Those fortunate owners of a drill spindle and elevating slide will probably elect to mount the blank on a mandrel between centres and run the end-mill in the drilling spindle through the overhead. In this way both sides and top of each tooth can be milled concurrently if the saddle and cross slide stops are suitably set.

The second way of doing the job is to make an end-mill profiled to the shape of the tooth, including both face and flank radii. The blank would then be presented sideways to the end-mill and fed along the tooth by means of the cross slide.

The diameter of this end-mill will depend on the amount of space between the teeth. This must be sufficient to allow the necessary movement of the end-mill along the teeth.

The periphery of the blank can be either finished off by hand or cut with a flat-faced end-mill, as in the first case.

Useful Tool Holders for the Workshop



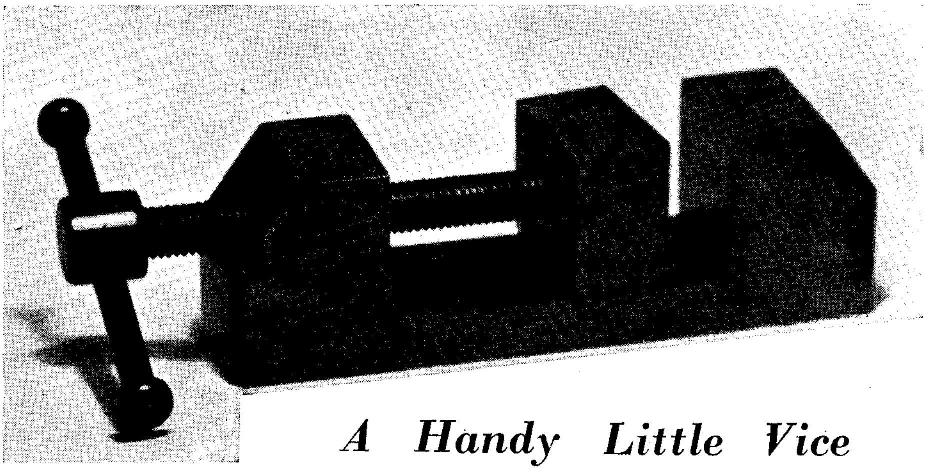
PRACTICAL tool holders and racks for the model engineer's workshop can easily be made from scrap pieces of galvanised corrugated sheeting.

The brace holder (*A*) is simply a 4-in. length of one of the corrugations. One side is cut slightly longer than the other and flattened; two screw holes are punched in the metal. The hook type holder (*C*) is just a smaller edition. The punch, drill and chisel rack or holder (*B*) will be found very useful in any workshop. Six or eight corrugations may be used as tool holders. An additional 10-in. section on each end is flattened, cut and bent as shown in sketch. It protrudes from the wall at a 40-deg. angle, and is securely held with two screws at each end. When cutting, a square inch of metal is left protruding at the lower end of each trough. This is bent upright to prevent the tools from sliding out. The sharp edges should be suitably rounded.

The hammer and spanner holder (*D*) is a 2-in. strip of corrugations, flattened at each end and nailed to the wall.

The components container (*E*) is an 8-in. strip of corrugated sheet with the desired number of grooves. This is butted tightly to the wall and screwed on the bench in each groove. A thin section is nailed to the bench, blocking the open ends.

The file rack (*F*) is another handy addition to the workshop equipment. This has 6 or 8 corrugations and is from 10 to 12 in, wide. The ends are flattened, cut and bent and screwed to the wall as depicted at (*F*). Nos. 22 or 20-gauge sheeting will be found most satisfactory.—A.J.T.E.



A Handy Little Vice

AN efficient small vice is often required by the model maker; one that will hold small jobs in such a manner that really accurate work can be accomplished. This vice is quite easy to make, and will satisfy this requirement.

Of squared-off construction it is useful for jobs on machine and bench alike, and can be used either flat on its base, on either side, or on end, as the case may be. For ordinary use it is held in the jaws of a larger vice.

Its dimensions can be varied according to individual requirements, but the measurements of the little vice here illustrated are as follows:—Overall length $3\frac{3}{4}$ in., squared-off width 1 in., height $1\frac{1}{4}$ in., depth of jaws $\frac{7}{8}$ in., jaws open to $1\frac{3}{8}$ in.

Material Required

- (*a*) 1 Piece mild steel $3\frac{3}{4}$ in. × 1 in. × $\frac{3}{8}$ in., finished.
- (*b*) 2 Mild steel blocks 1 in. × 1 in. × $\frac{7}{8}$ in., finished.
- (*c*) 1 Mild steel block 1 in. × $\frac{1}{2}$ in. × $\frac{7}{8}$ in., finished.
- (*d*) 1 Piece $\frac{1}{8}$-in. steel plate 1 in. × $\frac{7}{8}$ in., finished.
- (*e*) 1 $2\frac{3}{4}$ in. × $\frac{3}{8}$ in. B.S.F. steel bolt.
- (*f*) 1 $\frac{3}{8}$ in. B.S.F. steel nut.
- (*g*) 1 2 B.A. steel rod $2\frac{1}{2}$ in. long.
- (*h*) 2 2 B.A. steel nuts.
- (*i*) 4 4 B.A. C/S steel screws $\frac{3}{8}$ in. long.
- (*j*) 4 2 B.A. C/S steel screws 1 in. long.
- (*k*) 1 $\frac{1}{2}$ in. steel washer.

A hole is drilled centrally in one of the blocks (*b*) and tapped $\frac{3}{8}$ in. B.S.F. thread. The two blocks (*b*) are then drilled and tapped 2 B.A. and assembled on the base (*a*) with the 2 B.A. C/S screws (*j*), two to each block. The block (*c*) constituting the sliding jaw is drilled centrally $\frac{1}{2}$ in. to a depth of $\frac{1}{4}$ in.

Backing plate (*d*) is drilled centrally $\frac{3}{8}$ in. with full clearance and is countersunk on its outer side. Four 4 B.A. holes are then drilled in conjunction with the sliding jaw, which has to be drilled and tapped accordingly and matched.

The bolt (*e*) is threaded to its full length under the head, and nut (*f*) is screwed on and tightened down on to the head. From this hexagonal assembly a substantial boss can be turned in a few minutes on the lathe or in an electric drill. This boss is then drilled 3/16 in. clearance to accommodate the vice handle made from the 2 B.A. steel rod (*g*). This has been previously threaded each end just sufficient to take the 2 B.A. nuts (*h*). These two nuts are easily turned into a ball-end shape after the ends of the rod have been riveted over. Thus the dumb-bell handle is made.

The end of the vice bolt (*e*) is then reduced in its diameter for about $\frac{1}{4}$ in. to take the $\frac{1}{2}$ in. washer (*k*). Backing plate (*d*) is then passed over the thread of the vice bolt (*e*), and the bolt end riveted over to a ball-end shape after the $\frac{1}{2}$ in. washer (*k*) has been fitted on to the reduced end.

This ball-end takes the thrust on the sliding jaw when tightening the vice; the washer takes the withdrawal thrust when undoing the vice.

It can be seen from the illustration that the assembly of the sliding jaw is of a universal nature; this is why the backing plate should be well countersunk to allow full universal movement. Irregular and angular work can thus be held in a satisfactory manner as well as the usual parallel job.

If care is observed in the making of this little vice, quite light gauge material can be held and worked upon, the writer having used the vice illustrated to make some shims in 0.0015 in. material with no difficulty whatever.—P. REEVE.

To Chop or Not to Chop?

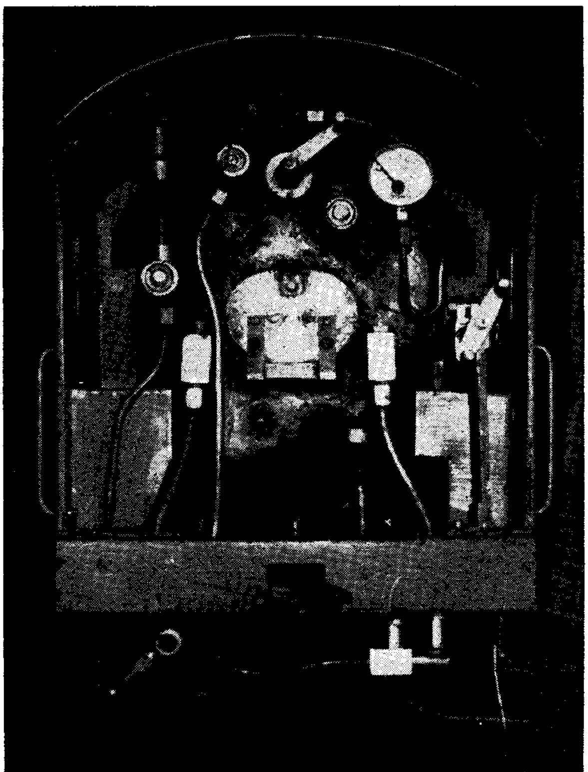
By "L.B.S.C."

THE extremely interesting letter by Mr. H. G. Greg on page 166 of February 12th issue, plus sundry direct letters from several correspondents who want to know if your humble servant has executed a complete *volte face* on the subject of locomotive exhausts, seems to call for a little comment and explanation; so let us have "five minutes in the lobby" on this subject.

Mr. Greg refers to my engine *Tugboat Annie*, and also refers to the "full-size" journal, the *Railway Gazette*. Readers who are interested in my steam rival to "Miss Milly Amp" will find a description of her, with drawings of the Holcroft conjugated valve-gear fitted to the inside cylinders, in the *Railway Gazette* of January 16th last. A photograph of the gear assembled and erected, taken before the boiler was put on, is also shown. On account of the paper restrictions, I don't suppose copies of the journal are available for sale, but probably they can be seen in the Reference Departments of public libraries. Your humble servant did not write the description referred to; that was done by a high locomotive official who inspected the engine and saw it under steam, and the drawings of the valve-gear were supplied by the inventor, Mr. H. Holcroft.

Mr. Greg says he always thought I was wrong in admiring locomotives that could "chop them off and lift the roof" when starting. Well, I still do, for reasons which I will explain in a minute or so; but what I *don't* admire, never did and never shall, is an engine that maintains a continual roar up the chimney all the time it is running, tearing the fire to bits, and consuming a tremendous amount of coal and water.

In the small sizes, such engines were usually failures as continuous runners, because the boilers were generally unable to maintain a sufficient rate of steam generation to provide the wherewithal to keep going. Now in my comment on Mr. Greenly's assertion that "expansion in small cylinders is pure rubbish"—an assertion, by the way, that Mr. Greenly has so far failed to prove—I remarked that as soon as my engine got away with her load and was notched up, the blast died away to the intensity of the cough of an asthmatic blackbeetle. I was not, of course, referring to *Tugboat Annie*, but to one of my ordinary two-cylinder locomotives with ordinary valve-gear and the usual arrangement of smokebox, blastpipe and chimney. The reasons for those loud snappy beats which I like to hear as the engine gets away in full gear are easily explained. First, I guess every reader and follower of these notes knows full well by this time. that my aim right through is to obtain the greatest amount of work for the smallest quantity of steam consumed; therefore, my valve-gears are arranged and my



The cab of Mr. C. T. Upton's "Miss 10 to 8."

valves timed to give a high degree of expansion when the engines are notched up and the cut-off is very early. Consequently, the exhaust pressure is low, as on a full-sized engine of efficient modern design and construction.

By one of the laws of Nature which cannot be altered, coal requires a certain amount of oxygen to consume it; and in a little locomotive firebox that oxygen has to be supplied from air drawn through the fire by the action of the blast. When the exhaust pressure is very low it requires a considerable amount of "wangling" to get a proper arrangement of chimney liner and blastpipe nozzle to induce the necessary current of air without causing back pressure in the cylinders; but there is one helpful factor, and that is, when the rate of steam consumption is low, the fire does not need to burn very fiercely, and therefore quite a moderate draught does the necessary.

So far, so good; but everybody knows that it requires much more steam to start a load from rest and accelerate it than is needed to keep it going *and that same steam has to be exhausted through the same blast nozzle and chimney*. Another one of my aims, and a necessity if the previous one mentioned is to be carried out, is that back pressure on the piston shall be reduced to an absolute minimum. Pressure of live steam on the piston should be transferred to tractive effort at the wheel treads, not expended in pushing spent steam out of a cylinder of the 100 per cent. cut-off variety, through tiny ports and passages. To that end I use large ports and passages, and again arrange my valve-gears and set the valves so that, directly the crank reaches such a position that further pushing at the crank pin has little or no effect, the exhaust port opens all-of-a-sudden-Peggy, and "out goes the gas" with great alacrity. It is this sudden release, and the speed at which the released steam dashes through the "wide open spaces" and swishes through the blast nozzle, that causes the well-known "L.B.S.C. chonk," as friends jocularly term it; it is definitely *not* caused by an excessive volume of steam. A fog signal is only the size of a button, and the fulminate caps inside are very tiny and insignificant; but it makes a dickens of a crack when the engine wheel squashes it and "splits the atom" in a manner of speaking!

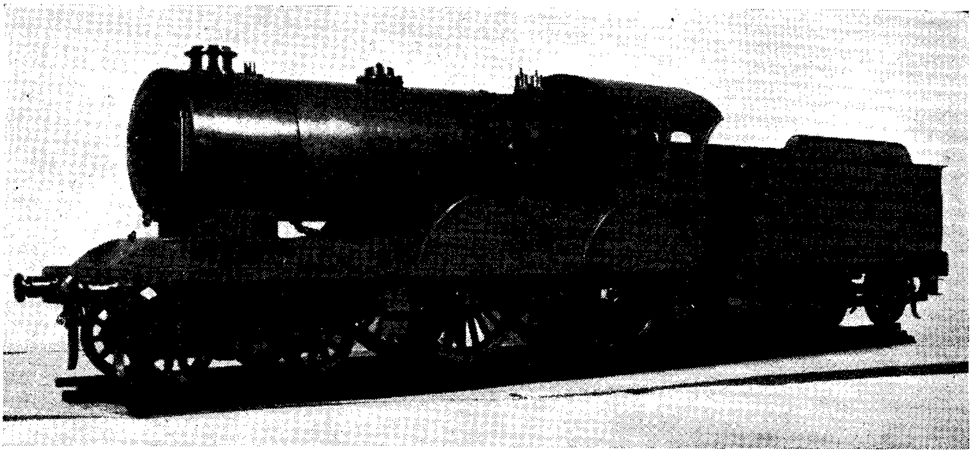
Where "Tugboat Annie" Differs

The late Sir H. N. Gresley, who was a "proper lad" for experimenting, found out that the smokebox vacuum drops to zero between beats. Every engine-driver and fireman knows full well that the continuous but gentle action of the blower has as much beneficial effect on the fire as the intermittent puffs of the exhaust when running slowly, although the latter may be violent enough to make the fire actually "jump."

The old steam locomotives of the District and Metropolitan Railways, 4-4-0 condensing tank engines, used to plod hour after hour around the Inner Circle, generating all the steam required to run their trains, by blower alone, except for an occasional few puffs up the chimney where the exit from a station was in the open air for a few hundred yards, e.g. the eastern end of South Kensington. It stands to reason that when there is no vacuum in the smokebox, there is no draught on the fire (sundry followers of these notes have discovered that for themselves, when their engines wouldn't steam, due to air leaks!) and therefore the "intermittent" vacuum, as we might call it, needs to be much higher than if the vacuum is continuous; ergo, as Hamlet might have said, if you could make the engine puff a bit quicker for a given rate of speed you could reduce the intensity of the beats by using a bigger blast nozzle or any other means, and still keep the home fires burning merry and bright. And, thanks to Mr. Holcroft, Mr. Baker, and M. Lemaître, that is exactly what I have done on *Tugboat Annie*. The cylinders on this engine, as I stated before, are arranged according to Great Western practice as far as location and drive are concerned, and they are proportionately bigger than those of a G.W. "King." Therefore, if the cranks were directly opposed, as on the G.W. engines, and the valve-gear and setting arranged in the way I usually set two-cylinder jobs, or four-cylinder-opposed-crank engines, two cylinders would exhaust together.

The sudden release of *two* lots of steam, rushing through ample-sized non-choking passages and pipes, and escaping through a blast nozzle and chimney of, say, normal G.W. dimensions, would produce a series of terrific cracks in full gear, which would probably have placed *Tugboat Annie* at the head of the "chopping-off" brigade right away. But the cranks are set at 135 deg. instead of being opposed; and that fact, plus what it entails, makes all the difference in the world not only to the starting effort and the acceleration but to the exhaust as well. Instead of two cylinders exhausting together, each one exhausts separately, so that we get eight beats per revolution of the driving wheels; and as each beat only discharges the contents of one cylinder, the blast is far less intense.

Even with the same valve setting as I would have used on an opposed-crank engine, there would have been advantages in the eight-beat arrangement; but with



" N.E.R. 750 " built by Mr. C. T. Upton.

the latter, full-gear cut-off can be made much earlier, as two at least of the cranks will always be in a good position for starting, and steam can be cut off before the point at which any of the connecting-rods cease to give an effective push at its crank-pin near the end of the stroke. Earlier cut-off means lower exhaust pressure and still lighter blast. Previous experience had taught me how far I could go with the cut-off business, but " Annie " has a Pennsylvania boiler, and the grate area is pretty big ; and I wondered if the exhaust, when running notched up, would be powerful enough to draw the requisite amount of air through the fire if a normal chimney and blastpipe were used. Mr. Greg says he " thinks large lumps of low-pressure steam can displace as much air as small lumps of high-pressure steam " ; but my trouble, as far as I could see, was that I would only have " small lumps of low-pressure steam," and how should I make the most of them ? I knew, of course, of the Southern Railway's experiments with Kylchap and Lemaître blastpipes and chimneys, and of the two I favoured the latter, because I figured that if I could get a steady stream of air induced through a chimney big enough to " ventilate " the firebox, it need not have any more velocity than a blower jet, as used on the old District, and the problem was solved.

" Tugboat Annie's " Blastpipe and Chimney

There is no separate chimney and liner ; both are comprised in one piece of copper tube $1\frac{1}{8}$ in. diameter, which is belled out a little at the bottom, and projects $\frac{1}{4}$ in. through the top of the smokebox, being adorned with a half-round lip, and a flange at the bottom of the projection, about $\frac{1}{4}$ in. wide, for the double purpose of keeping it in place and making it look pretty. The flange is brazed to the tube and attached to the smokebox by screws.

The combined blastpipe cap and blower is a comical thing to look at, but it certainly does the doings in champion style. The blastpipe itself is $\frac{3}{8}$ in. diameter, and screwed at the top. The cap is $\frac{1}{2}$ in. diameter, hollowed out and tapped to screw on the pipe. Around it is a channel-section ring, a little over $\frac{1}{8}$ in. square ; the open side of the channel is next to the cap, and, being silver-soldered to it, a steam passage is formed all around the cap. Three No. 70 holes are drilled equidistant around the top, and a $\frac{1}{4}$-in. by 40 union is attached to one side for connecting up the blower pipe. Steam issuing from the three holes fills the chimney and maintains plenty of draught when the engine is at rest, but unless the valve is full open (which isn't necessary) there is no sound except a slight hiss, the usual blower " roar " being entirely absent.

The blastpipe cap carries four jets made from $\frac{1}{8}$-in. copper tube and silver-soldered in. Three of them are spaced equidistant around the edge ; the fourth is in the middle. Only the first-mentioned are in use at present, as the fourth will be fitted with an arrangement to open and close it from the footplate, when I get time to scheme out and install a suitable device, and is intended to act as extra relief and prevent any back pressure, when the engine is eventually tested " all out " to see what she really can do. The low-pressure exhaust, coming in a steady stream from the three jets, fills the chimney and has a blower-like action on the fire, maintaining it so that the safety-valves are on the sizzle all the time when running, with the boiler feed working ; yet the fire is not lifted, and nothing goes

through the tubes into the smokebox.

I knew the exhaust would be quiet, as the Baker valve gear allows of a very "precise" valve setting, and Mr. Holcroft's wonderfully ingenious arrangement of levers for actuating the inside valves allows of a setting just as accurate; it goes without saying that I took advantage of the eight-beat setting to cut the steam consumption to the lowest possible. But to be absolutely honest, I didn't expect the blessed beats to give just a little purr when starting, as much as to say "Here we are, all present and correct, sergeant!" and then disappear altogether. Mr. Greg is a little too generous in ascribing the credit to your humble servant; as I said before, I only built the engine, incorporating the "brains" of the good folk mentioned, and to them the greatest credit is due.

Relief of Back Pressure

The device mentioned by Mr. Greg as being used on the Lehigh Valley RR. to relieve back pressure, by letting part of the exhaust escape direct to the atmosphere, is only another version of an old idea. I cannot recall "chapter and verse" at the moment, but I have both read and heard of similar devices which were hand-operated. Variable blastpipes, fitted with the object of relieving back pressure, are, of course, well known ("Annabel" has one), and the jumper top fitted to the blastpipes of Great Western engines is for the same purpose. But to allow the surplus exhaust to escape into the atmosphere is pure waste; and the Stroudley engines on the old Brighton used to return a portion of the exhaust steam to the tenders and tanks, thereby not only softening the blast, but utilising the heat in the steam that would otherwise have been wasted. Trust "old man Billy" to do anything which would improve the running of his engines! Regarding Mr. Greg's suggestion of opening out the blastpipe, and using the blower if the steaming of the engine were affected, I have tried the effect of running without any blast at all.

Some years ago, I carried out some experiments in connection with superheating and feedwater heating, and in one instance the whole of the exhaust steam was turned into the water tank, relying on the blower only to maintain the fire. The engine steamed all right, but there were two factors which helped it; one being that the feedwater was practically at boiling temperature, and the other that the valve-gear and setting was arranged as usual for the absolute mimimum of steam consumption. Whether Mr. Greg's suggestion would pan out all right on the average small locomotive is, I should imagine, one of those things which could only be determined by trial on the actual engine; but, to my idea, it would be a sheer waste of live steam to use it for a job which could be done by exhaust steam alone, provided that the blastpipe, nozzle, and chimney liner are all properly proportioned and fitted. I have already fully explained, and demonstrated on the road, that back pressure in the cylinders can be reduced to the absolute minimum by attention to the above points and correctly-timed exhaust port opening.

As a matter of fact, most British locomotives *are* actually fitted with an auxiliary exhaust-pressure relief, in the form of our old friend the exhaust injector, which takes a fair amount of exhaust steam from a point as near the cylinders as possible, and considerably reduces the amount going through the blast nozzle. Thus there is a threefold advantage, viz., less pull on the fire; lower back-pressure in the cylinders, as part of the exhaust steam is rushing into a vacuum when the injector is working; and heat in the exhaust steam, which would otherwise be wasted, is transferred to the feedwater when the steam is condensed in the injector.

Mr. Greg refers to the light exhaust of certain French locomotives. These are compounds, and compound engines are noted for having a soft, watery and woolly exhaust. They have tremendous boilers to supply a small pair of high-pressure cylinders with steam, and it is the double expansion which reduces the exhaust pressure and temperature to the wet and woolly stage. Incidentally, I have the correct valve setting for some of these engines, and it would give certain good folk a shock if I disclosed it.

The American Mallet freight engines also ran wet and woolly, especially before high-degree superheating came into vogue; some of the brakemen, who had to go along the tops of the cars when the train was in motion, could testify to that in good railroad Esperanto!

To sum up, it isn't so much the exhaust at starting that matters; what counts is the exhaust *when running*. An ordinary two-cylinder, four-beat engine with correct valve-gear and setting will always give sharp cracks as she gets off the mark in full gear; but when running well notched up, she will only purr. The reason *Tugboat Annie* is so quiet is merely because the starting torque is so even, being spread over eight impulses, that a much earlier cut-off and lower exhaust pressure can be employed; and on top of that the multiple-jet blast nozzle splits up what there is of the exhaust steam into little streams, and so puts the finishing touch on it.

Semaphore Signals of the Cheshire Lines Committee

By O. S. NOCK, B.Sc., A.M.I.Mech.E., M.I.R.S.E.

IN concluding the main series of articles describing the semaphore signals used on British railways in pre-grouping days I wrote " —— although matters will no doubt be a good deal more standard than hitherto, there will be many 'local' features to puzzle the casual observer, and to delight the connoisseur." Since then some further information has come to hand from a Stockport reader, Mr. G. H. Platt, which has enabled me to add the signals of the Cheshire Lines Committee to the main series. This is a welcome addition, for the C.L.C. used, and still uses a highly distinctive design. Before 1923 lower-quadrant arms were used ; then after the grouping, when the C.L.C. remained a joint line, having its own signal department and works at Warrington, the original type of arm was retained until about 1930. By that time, the British standard upper-quadrant type of arm was coming into fairly general use on

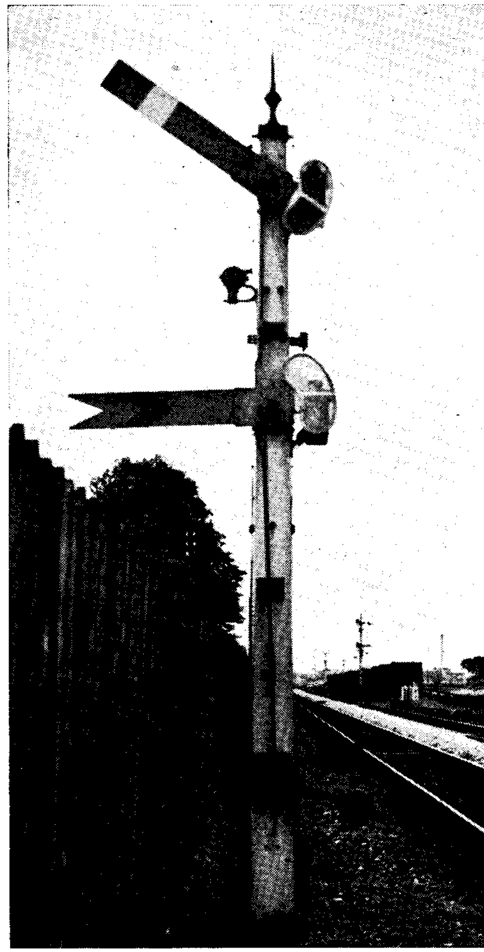


Photo by] [G. H. Platt

Fig. 4. Present-day two-arm signal on concrete post.

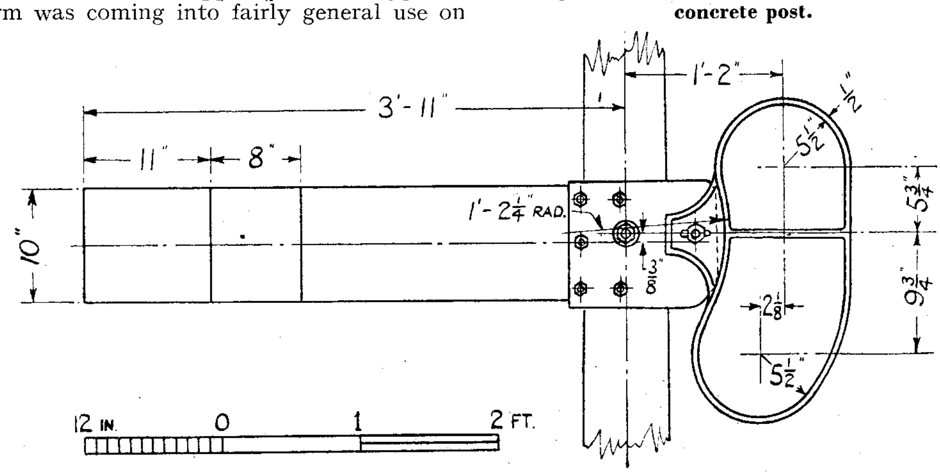


Fig. 1. The former standard C.L.C. lower-quadrant arm and spectacle.

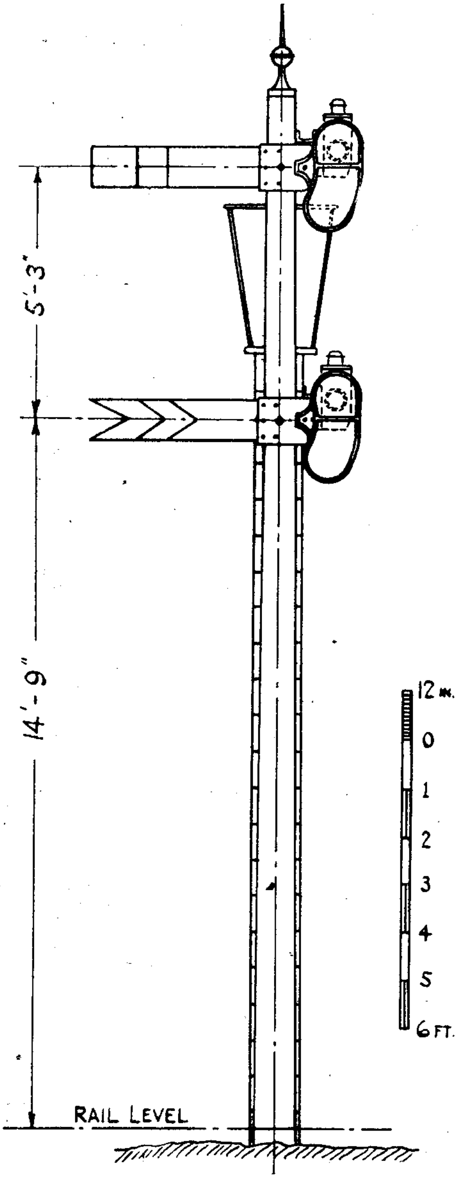


Fig. 2. C.L.C. 2-arm lower-quadrant signal.

the L.M.S. and L.N.E.R., and the C.L.C. brought out an upper-quadrant design of its own, totally different in appearance to the B.S. arrangement.

The original lower-quadrant signals have some resemblance to those of the Great Central railway, though the spectacle, as shown in Fig. 1, was of a somewhat unusual shape. This casting had a tongue on the back of the lug which fitted into a groove in the arm plate, the hole in the spectacle lug being slotted to provide adjustment. The posts were wooden, and the arm spindle was carried in bearings at both front and back. Fig. 2 shows the general arrangement of a two-arm signal of the old type; in this drawing the shorter variety of semaphore arm is shown, measuring 3 ft. 11 in. from pivot to the tip. For signals over about 25 ft. similar arms, 4 ft. 11 in. long, were used. The same general design of arm has been retained in the new upper-quadrant signals, and in all cases the arms are made of wood. The longer arms are reinforced by a band near the outer end.

The present upper-quadrant arrangement is illustrated in Fig. 3. In this the lamp has been retained on the right-hand side of the post, as in previous practice, and the spectacle looks like a lower-quadrant one turned upside down; actually, however, its

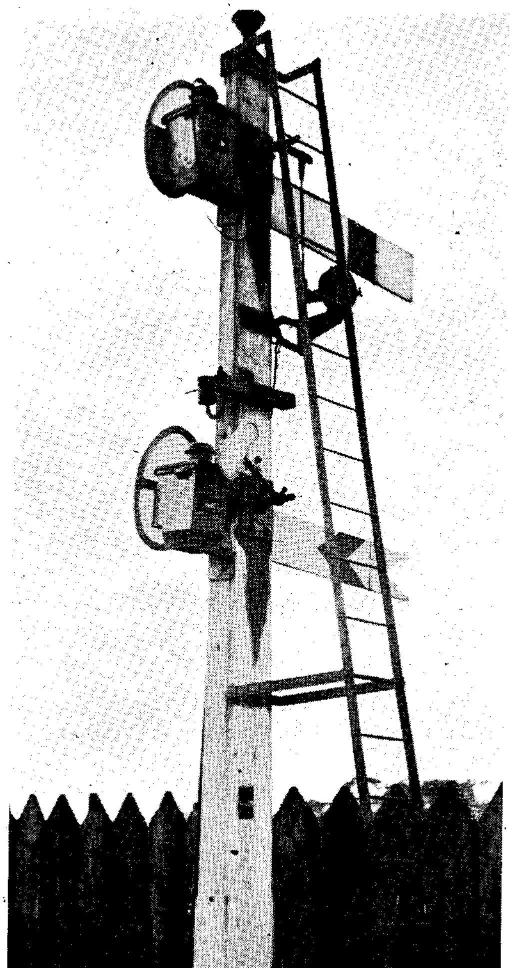


Photo by] [*G. H. Platt*

Fig. 5. Cheadle "up" starter; a typical C.L.C. arrangement.

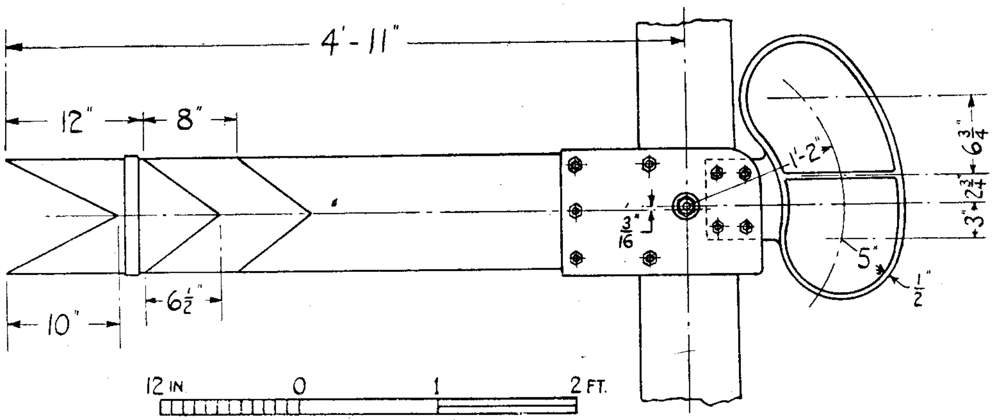


Fig. 3. C.L.C. present-day upper-quadrant arm and spectacle.

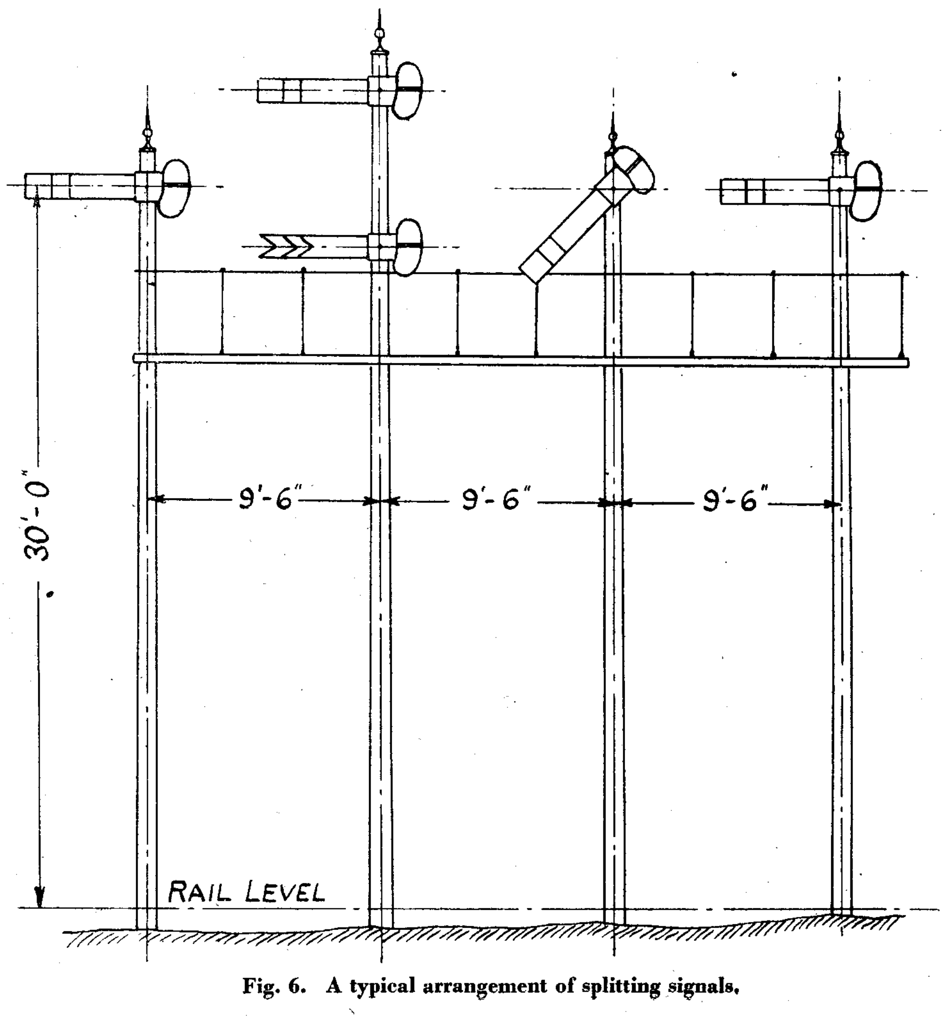


Fig. 6. A typical arrangement of splitting signals.

shape is somewhat more straightforward than the old C.L.C. pattern, and in this design the arm must out-balance the spectacle, so that the signal goes to danger in the event of a breakage in the operating rod. At first sight, these signals look like lower-quadrants, due no doubt to our associating all upper-quadrant signals with left-hand lamps; the general appearance of a two-arm assembly is shown in the photograph reproduced in Fig. 4. A change has also been made from wood to reinforced

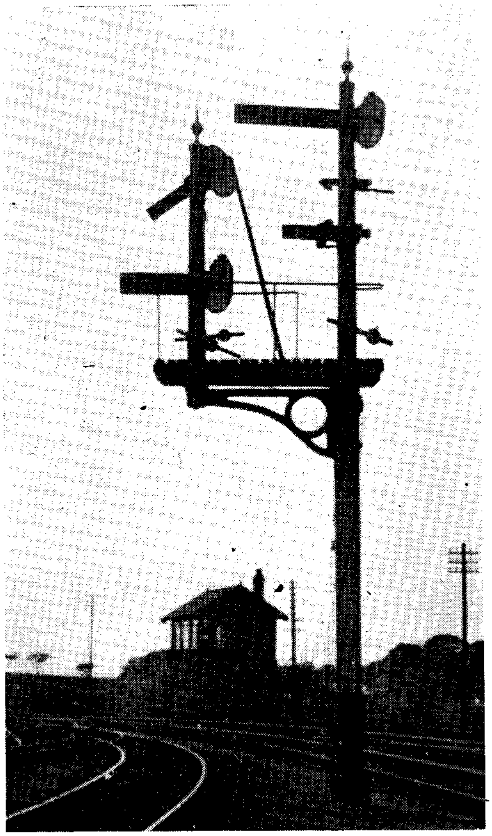


Photo by] [*G. H. Platt*

Fig. 7. Bracket signal at Godley, with shunt mounted above full-sized arm.

concrete posts, and these latter are peculiar in being of rectangular section. At the top they are 8 in. wide by 3 in. thick. This peculiarity is shown very clearly in Mr. Platt's fine photograph of the Cheadle "up" starter, in Fig. 5. This picture illustrates a number of other interesting features, including the backlight blinder for the distant arm, which consists of a shade casting mounted on the end of a plain "stick." In the new signals no landings are provided in the ladder arrangement. Fig. 5 shows a typical layout, which may be compared with the old style design in Fig. 2.

In addition to the distinctive spectacle, the C.L.C. signals included some rather unusual gantry arrangements. Instead of using bracket signals of the usual general style, a lavish use was made of posts, as though each doll were continued to ground level, with a staging to provide access to all the semaphores. Fig. 6 shows diagrammatically the general principle on which these configurations were built up, this particular arrangement being used at Heaton Mersey for some years. Latterly, brackets of the orthodox type have been installed, and in connection with these Mr. Platt mentions an unusual example at Godley, where a shunt arm is mounted *above* a full-sized arm. This is actually a loop-exit signal, and the generally accepted principle of "top arm reads to the left-hand road" has here been followed to the letter, since the small arm relates to a shunting neck, and the large lower arm reads out on to the main line. This signal is illustrated in Fig. 7.

Lower-quadrant shunt arms were of the same general design as the main line arms, though only 7 in. wide, and measuring 2 ft. 9 in. from pivot to tip. Formerly, they carried a white letter "S" 12 in. high on the face of the arm, after the G.W.R. style, and in conjunction with this a second lamp was mounted on the left-hand side of the post; when the arm was horizontal this lamp was obscured, and when lowered, an illuminated letter "S" was revealed. This night indication was provided in addition to the ordinary coloured lights from the spectacle. Thus, in semaphore signalling at any rate, the Cheshire Lines has maintained a striking individuality, and added one more example of the apparent British determination to avoid at all costs the complete standardisation of railway equipment.

CLEANING BRASS

Discoloured and corroded brass can be cleaned if it is immersed for a short period in a weak nitric acid bath. The latter may consist of one part acid to five parts water, the length of immersion depending upon the condition of the article; frequent inspection is the best guide. After removing from the bath, immerse for a few seconds in strong washing soda.

A quick and cheap method of doing this job is to rub them well with a mixture of salt and vinegar; or oxalic acid may be used instead of ordinary vinegar.

A good cleaning fluid for brass and copper is made from: oxalic acid 1 oz., rottenstone 6 oz., and enough whale oil and spirit of turpentine (equal parts) to mix into a soft paste.—W. F. COMERFORD.

*LOCOMOTIVE HEADLAMPS —

By F. C. HAMBLETON

No. 4—London & North Western Railway

REFERENCE has already been made to the fact that John Ramsbottom was one of the pioneers of the small engine headlamp. Like so many engineering details emanating from Crewe his design of lamp was in use on this line for a very long period—upwards of sixty years, for it was not until the time of the L.M.S.R. amalgamation that they began to disappear (Fig. 1).

The L.N.W. lamps possessed two features dating back from the old road "Royal Mail Coach" period. These were the square foot and the red rear light. The lenses employed were most peculiar, for although of bullseye form they were of uniform thickness and thus might be termed "hollow lenses." They did not magnify, and the flame could actually be seen through them; strangely, too, the white projected more than the red lens. Such lenses were also employed on the Metropolitan & District lines. To increase the volume of light a silver-plated double-coned reflector (Fig. 2) threw

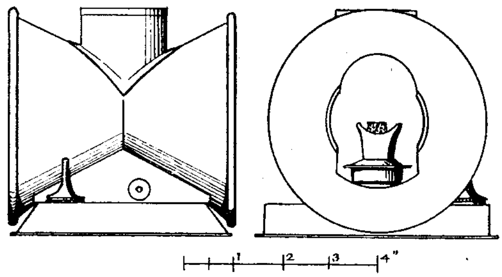


Fig. 2.

beams of light in both a forward and backward direction through the lamp. These reflectors must have required a considerable knowledge of solid geometry on the part of the designer when setting out the requisite patterns for the guidance of those skilful craftsmen, the tinsmiths.

The whole thing was quite a work of art. The flame was situated at the junction of the two cones. The top of the lamp carried a very neat brass label bearing the words "London & North Western Railway Co., Makers. Locomotive department. Crewe."—thus there could be no dispute as to ownership!

In Ramsbottom's days there were only two positions for the lamps, one over each buffer, and the sockets provided to hold the lamps were quite heavy castings. (Fig. 3).

* *Continued from page* 246, *"M.E.," March* 12, 1942.

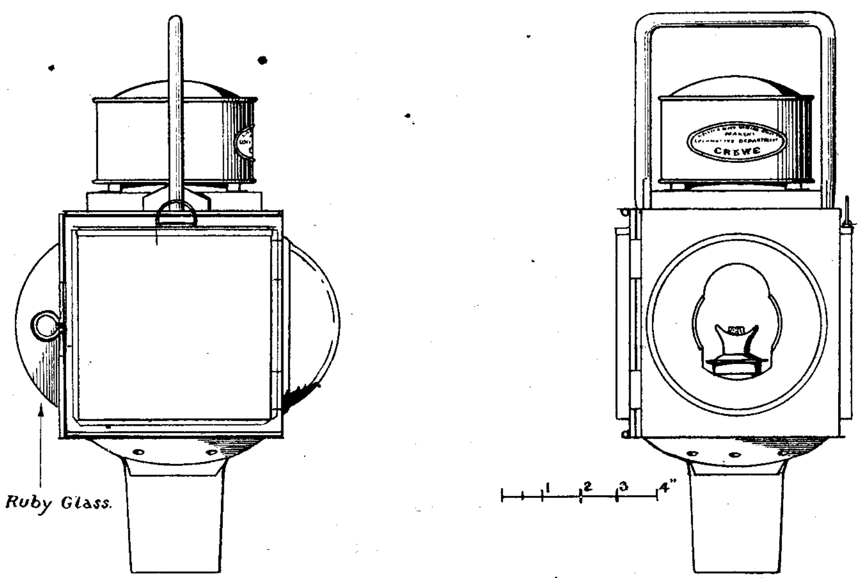
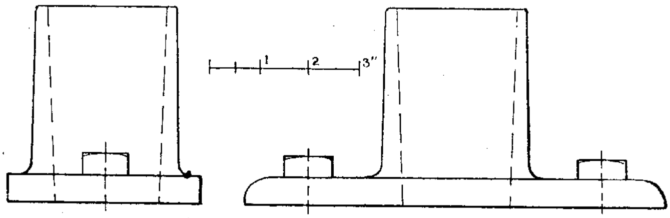


Fig. 1. The Ramsbottom headlamp on the L.N.W.R.

Fig. 3. Lamp sockets fitted over buffers.



When Webb designed the " Precursors " and " Precedent " class of engines, a third socket was introduced and was placed at the top of the smoke-box (Fig. 4), the lower holding bolt of which was formed so as to provide an eye to which was attached a short length of chain. This chain served to support the smokebox door (which in those days was hinged horizontally at the top) when open. This eye is marked *A* in Fig. 4.

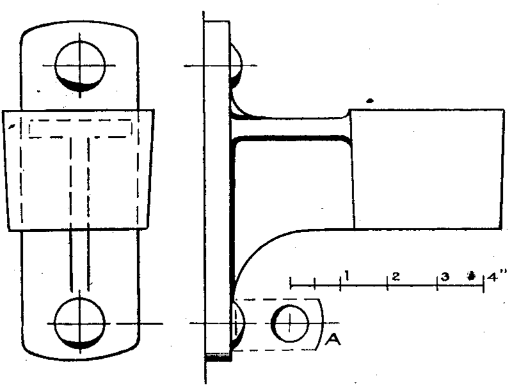


Fig. 4.

When the " Experiment " compound engines were built they were given the usual circular smokebox door, and a new type of lamp socket was introduced which served also as a support for the handrail. (Fig. 5.) The earlier type, however, was retained by Webb for use on the bunkers of the tank engines, in which case they were secured to the backplates by two holding bolts.

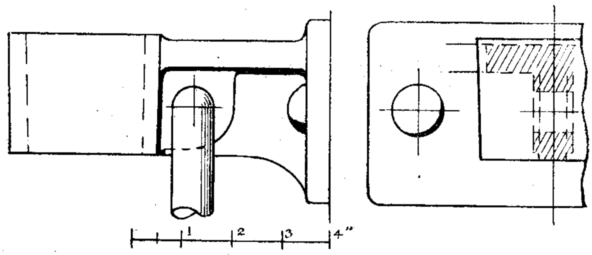
It was said by an eminent engineer that he considered Webb must have saved the L.N.W.R. thousands of pounds by retaining, through his long régime at Crewe, such standard details as these. The lamps had side pockets for the storage of green shades. The glass used was of a beautiful deep green, and was very thick—a fact which rendered the light almost invisible at a short distance ! The arrangement of the foot was rather a nuisance, inasmuch as the lamps could not stand upright, and this made them inconvenient things to clean, or to fill up and light. Also, after a period of 40 years it was suddenly found that red rear lights shown on the engines themselves might lead to conflicting signals, and accordingly blinders were issued which could be slipped in front of the red lens to obscure the rear light whilst running forwards.

Very Fascinating

But, perhaps, after all is said and done, these little peculiarities only endeared these familiar old lamps to the L.N.W. enthusiasts —and they were many. Certainly, at night they appeared very fascinating. When placed at the top of the smokebox one saw the ruby light reflected from the base of the chimney, and, viewed from the front, one got a glimpse of a spot of emerald green surrounded by a concentric ring of the same delightful colour. Memories, too, come floating back of that black beauty, *Jeanie Deans*, carrying her express train codes—a white light over each buffer—standing in the dusk at Crewe after her run with the famous 2 p.m. express from Euston. A whiff of steam would come floating up from the cylinders and as it passed the lamps it would become stained with shafts of ruby and silver light. Yes, those old headlamps had a charm all their own.

(To be continued)

Fig. 5. The new type of lamp socket on compound engines.



*Modelling Antarctic Exploration Ships

A description of four 1 mm. to 1 ft. scale models

By M. EDWIN MOON

I SHOULD have mentioned that the cross trees require to be cut off about 10 mm. long overall and the ends filed square with a groove filed in the ends to hold the top-gallant shrouds in place.

Make up all the yards, and steady them in place with pins while they are being soldered on to the masts. Where needed, the gaffs, or fore and aft spars, are soldered on at the same time. When you have finished the masts, wash them in methylated spirit to remove traces of flux and grease, and paint them. *Nimrod's* masts are brown and white.

The mainmast has only cross trees, similar to those on the fore, and the mizzen is a plain length of darning needle.

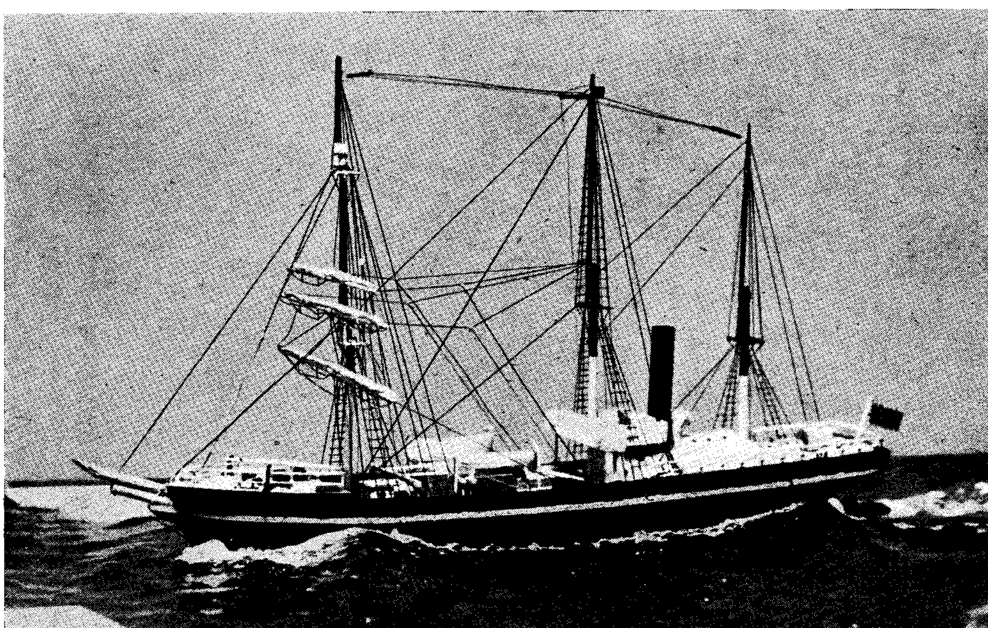
When the paint is quite dry, model the furled sails by rolling out a thin " sausage " of putty, and press it into place on the yards. Paint it a very pale grey. Also, put the furled sails at the aft side of the masts.

* *Continued from page* 269, " *M.E.*," *March* 19, 1942.

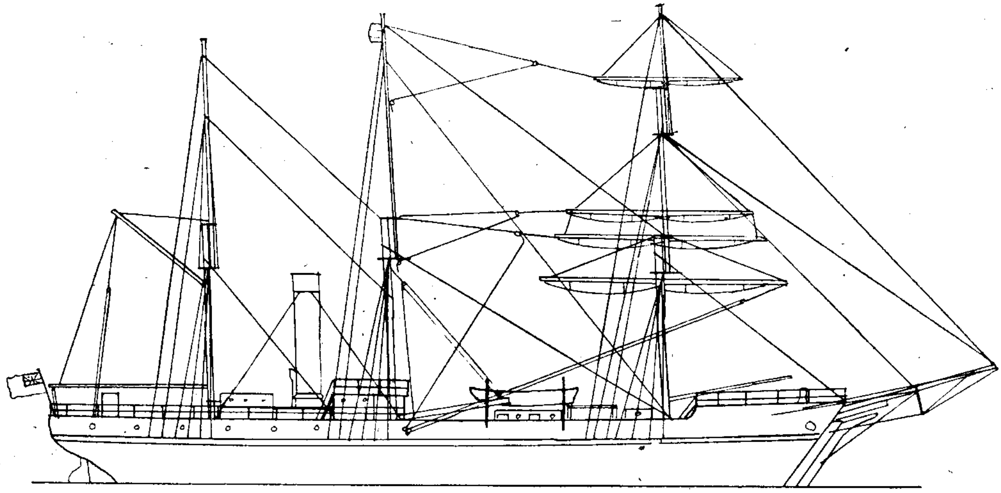
Now lay the masts, one at a time, yards downward on a cork table mat covered with a piece of waxed paper, such as that used to make packets of food air-tight. This will prevent the mast from sticking to the mat if you are a little too liberal with the seccotine, which you must apply to all knots used in the rigging to stop them from slipping. Now get some fine silk thread, Pearsall's is by far the best, but ordinary sewing silk will do. Black or very dark brown for the steel ropes, and a light brown or dark straw to represent the manila ropes in the running rigging. Secure the mast in place with a few pins.

Rigging

In the interests of neatness an unsightly bunch of knots at the ends of the yards must be avoided, and with a little forethought only one knot need appear at each yard-arm. Take a length of thread, about 18 in. long, and tie a slip knot in it as shown in Fig. 16, and place the loop *C* over the mast-head, and haul taut the ends *B* and *A*. Note that



The 1 mm. to the foot scale model of the S.Y. " Aurora."



Elevation and rigging plan of the S.Y. "Aurora."

the end *B* must be made fast first, to prevent the knot loosening. This thread will be the lift which holds the topgallant yard from tilting. Now take another thread and pass it under the truss from left to right, up across the top of the truss and down under again from left to right, forming a loop round the truss. Now stick in a pin about 3/16 in. from the end of the yard, and just below it, and another about the same distance from the mast. These pins are to keep the foot-rope, which you have just rove, at the proper distance from the yard. Now knot the lift rope round the end of the yard, about $\frac{1}{8}$ in., and catch in the foot-rope. You now have two ends of rope at each yard-arm. One will be used to make the pendant for the braces, and the other will form the sheet leading to the yard below.

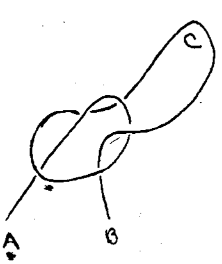


Fig. 16. Slip knot used in rigging.

Next, rig foot-ropes to the next yard down—the upper topsail yard. The lift simply passes over the head of the topmast. Now tie the foot-rope and lift rope to the yard, using the ends of the lift rope of the yard above. Similarly, rig a foot-rope to the lower topsail yard. This yard has no lifts, so tie this foot-rope down with the same thread that you used for the upper topsail yard. the lowest, or course yard lift and foot-rope, are rove off as upper topsail yard. Touch all knots with thin seccotine, and stick thin, short ends of silk on to make the stirrups reaching from the back of the yard to the foot-rope. (See photos.) Trim off any unwanted ends, leaving only one rope at each yard-arm.

Now for the shrouds. Put a slip knot over the mast-head, close to the lift, and lead the two ends over the ends of the cross trees; repeat on the other side. Tie these four ends to the mast $\frac{1}{4}$ in. below the cross trees with a short piece of thread, glue and trim off. Take another thread and pass it up between the cross trees, through the space between the masts, round the topmast, and down through the cross trees again. Repeat on the other side, and tie down as you did for the shrouds above. This completes the rigging that may be done on the board, so now step the masts into holes drilled in the

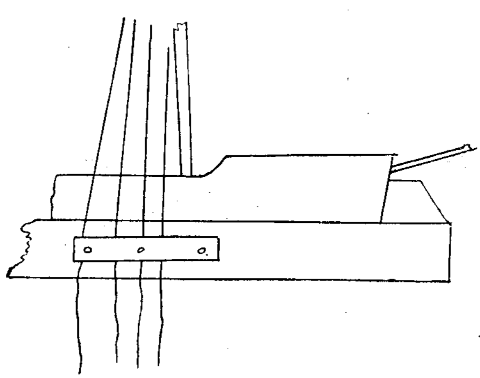
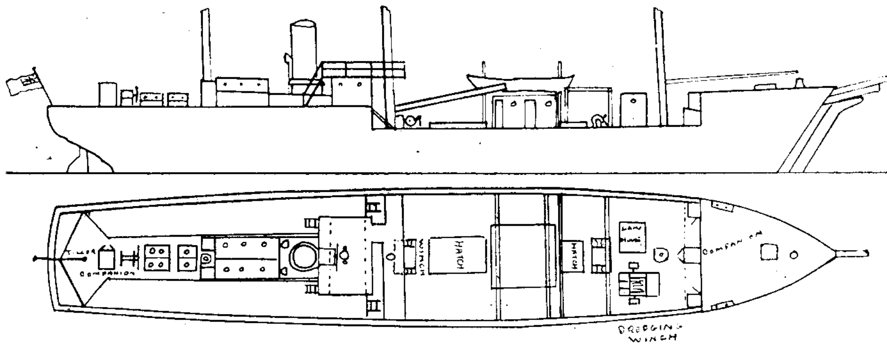


Fig. 17. Method of securing shrouds for glueing.

hull and secure them with a touch of glue. See that they are square to the beam of the ship, and give them a rake aft. Put on the lower shrouds on the mizzen first. Slip knot over the mast, with another caught



Midship section and deck plan of the S.Y. "Aurora."

under will make the three shrouds needed here. Bring them down the side of the hull, and make fast with a slip of wood pinned to the base while you glue them. (Fig. 17.)

The backstays are slip-knotted over the mast-head, and secured in the same way as the shrouds. Now tie a thread round the mainmast just below the cap, and lead it aft and hitch it round the mizzen mast-head, and the other end tie a little lower down and continue it out to the spanker gaff, where it is fixed with another thread, having a slip-knot tied in it to form the vangs which keep the gaff steady, and then it is taken down to the boom, then tied off, with another thread under it to make the boom sheets. Tie the vang pendants to the middle of a length of manila-coloured thread, and secure the ends of the latter inside the bulwarks near the stern. Complete the rigging of the remaining masts along the lines already laid down.

The stays between the foremast and bowsprit call for special mention. A thread is tied to the mast-head, led down to the end of the bowsprit, where it is made fast, catching in three short ropes, which are used to form the two outer bowsprit guys, and the martingale. It then passes round above the topmast cap, back to the bowsprit, where it holds in the two inner bowsprit guys, and the bobstay. The forestay passes round the mast above the top, and is led down and secured by adhesive in two small holes just inside the forecastle rail. The fore braces are run in a similar manner to the vang tackles. The knots are touched with a drop of fairly thick seccotine and painted white to represent blocks.

Ratlines are quite simple to make and fix. First tie a six-foot length of thread to a convenient nail, and hang a weight on the end. Rub in some thin seccotine with the thumb and forefinger, and leave to dry, then cut into half-inch lengths. Thread these through the shrouds, basket fashion, over one, under one, all the way up. Brush the shrouds and ratlines with thin glue, and when dry, trim off the ends with a sharp, pointed pair of scissors. A darning needle stuck in a wooden handle and a fine pair of tweezers will come in handy here.

Aurora

The principal dimensions of the S.Y. *Aurora*, of the Trans-Antarctic Expedition, 1914-1917, are :—Length on waterline, 144 ft. ; overall, excluding bowsprit, 165 ft. ; beam, 30 ft. ; foremast, truck to deck, 90 ft. ; mainmast, truck to deck, 87 ft. ; mizzen-mast, truck to deck, 78 ft. ; course yard, 52 ft. ; lower topsail yard, 43 ft. ; upper topsail yard, 38 ft. ; topgallant yard, 31 ft. ; mizzen gaff, 25 ft. ; mizzen boom, 32 ft. ; and bowsprit, 30 ft. Gross tonnage, 551. She was built at Dundee in 1876.

The illustration of this ship shows her as she was after a collision with the Barrier in the Ross Sea on January 9th, 1915, when she broke her jibboom and carried away the stays. This ship also has a well deck amidships. Note that the bridge projects beyond the house which carries it, and is supported on two stanchions to the bulwarks. The mast passes through the bridge to the deck below. The forecastle is cut away slightly, and the deck overhangs to the dotted line shown on the plan ; it is best put on as a separate piece.

Unlike the two preceding ships, *Aurora* was steered from the bridge by means of a wheel mounted at the after end, and controlling the rudder by means of two chains passing along the deck to the tiller. An emergency hand-wheel was fitted just before the after companionway.

Colours

Hull, black, with white line. Masts, black and white. Yards, white. Deck-houses, white. Funnel, black. Boats, white. Ventilators, white. Hatches and winches, black.

(To be continued)

Letters

Repairing a Stripped Lead Screw Nut

DEAR SIR,—Referring to Mr. Geo. Gentry's article, "An Interesting Small Lathe," in THE MODEL ENGINEER of December 4th, 1941, perhaps he may like to hear of the method of repairing a stripped lead screw nut I saw done some years ago.

The bore of the stripped nut was cleaned up; a square rod of metal having the same width as the spaces between the threads of the lead screw was coiled into a helix and *soldered* into the now plain bore of the nut and, hey, presto! there was a nut for the lead screw which served to cut the thread in a new permanent nut.

Yours faithfully,

Birmingham. T. P. STUCHFIELD.

Wooden Bushes

DEAR SIR,—I cannot quite make up my mind whether we old hard-bitten engineers are being "led up the garden," or if the "amateurs" really believe they have made momentous discoveries or revolutionary inventions. Some weeks ago one of your correspondents was elated with his solution of a transmission problem by means of a "flexible" coupling. He was disappointed later by being shown an illustration of the self-same coupling, this illustration being taken from a makers' catalogue. In point of fact, the patent rights on that particular coupling expired somewhere about 25 years ago. Further, the coupling is "concentric" and not "flexible."

Now, we have Mr. John McKay, from somewhere in Scotland, explaining how he has bushed a loose pulley with wood. Here again, we find that this method has been proved successful over a period of at least 30 years. These cases, together with many others, prompted my first paragraph.

Now that is finished with, let me be helpful!

If Mr. MacKay bushed his pulley as an experiment and without having any knowledge of the commercial product, it is remarkable how very near he is to complete success. I can assure him that his bush will prove remarkably efficient, silent in operation, and will *not* require any lubrication. His only fault is that he used oil for the impregnation and not a semi-solid lubricant.

We have to thank the Americans for the original experiments, and the writer has personal experience of the first commercial product put to use. This bush was inserted in the loose pulley of a 50 h.p. flat belt drive, the belt being leather, heavy double, copper stitched, and after 15 years of constant running at about 12 hours per day, is still in reasonably good condition and has *never been lubricated*.

We all remember the old saying that you cannot get a pint into a half-pint pot, but, like a lot of these old sayings, modern science persists in proving them wrong, time and again. If you care to fill the half-pint pot, loosely, with fine softwood sawdust, you will be surprised at the volume of water it will absorb without much increase in its own dimension. The same thing applies when we impregnate a wooden bush; and after years of experiment, two methods of impregnation have been evolved, but in each case the same type of wood is used.

The two methods are as follows:—For ordinary light duties the bushes are made from specially treated Canadian maple impregnated with mineral oil by pressure and vacuum process. For heavy duties a further impregnation with white metal and graphite is given. This metallic and graphite impregnation is not just a surface coating, but completely penetrates the bush. It has been proved that the bushes will stand a loading up to 100 lb. per sq. in.

The bushes are supplied slightly oversize on the outside diameter, and are chamfered off to provide easy entrance to the pulley boss. The driving fit slightly compresses the wood and the bore is correspondingly reduced. The bore is then finished by reamering out in the usual way. One word of warning, however. There are a number of patent rights still in force on these bushings.

To conclude, let me tell one against myself. "Donkey's years" ago, when these things were first produced, I was very proud of their performance and carried the results of our experiments, together with a sample bush, in my pocket. One very hot day I called upon an old friend of mine in Bradford, a consulting engineer by the way, proudly produced the bush and proceeded to expound modern theory as applied to "Bushology." After jabbering away for some time, it dawned upon me that I was being pitied. As I happened to have a reputation for leg pulling, it was obvious that my friend was waiting for the trap to be sprung. Another attempt to be serious, and then sez he, in biting sarcasm, "What the . . . are you trying to sell me? The main bearings out of Noah's Ark?"

Well, I staggered out, hung on to the railings and wept, until chancing to feel in my coat pocket I found that the bush, under the influence of the summer sun, had parted with quite an amount of impregnation. In arithmetical progression I counted very slowly up to ten!

Yours faithfully,

Stockport. "OLD GAUMLESS."